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Paper 7
Entered: December 10, 2021

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

MOMENTUM DYNAMICS CORPORATION,
Petitioner,

v.

WITRICITY CORPORATION,
Patent Owner.

IPR2021-01165
Patent 7,741,734 B2

Before JAMESON LEE, SALLY C. MEDLEY, and SCOTT RAEVSKY, *Administrative Patent Judges.*

LEE, *Administrative Patent Judge*.

DECISION
Denying Institution of *Inter Partes* Review
35 U.S.C. § 314

I. INTRODUCTION

Momentum Dynamics Corporation ("Petitioner") filed a Petition (Paper 2, "Pet.") requesting *inter partes* review of claims 1–7, 13, 19–22, 25, 26, 29, 30, 33, 34, 37, 38, 41, 42, 45, 46, 49, 50, 53, 54, 57–62, 64, 65, and 67–70 of U.S. Patent No. 7,741,734 B2 (Ex. 1001, "the '734 patent"). WiTricity Corporation ("Patent Owner") filed a Preliminary Response (Paper 6, "Prelim. Resp.").

Under 35 U.S.C. § 314(a), an *inter partes* review may not be instituted unless it is determined that there is a reasonable likelihood that the petitioner would prevail with respect to at least one of the claims challenged in the petition. Based on the information presented in the Petition and the supporting evidence, we are not persuaded there is a reasonable likelihood Petitioner would prevail with respect to any claim.

The Petition is denied, and no *inter partes* review is instituted.

II. BACKGROUND

A. Real Parties-in-Interest

Petitioner identifies only itself as real party-in-interest. Pet. 76. Patent Owner identifies Massachusetts Institute of Technology and WiTricity Corporation as real parties-in-interest. Paper 3, 1.

B. Related Matters

Petitioner and Patent Owner identify the following litigation as one in which the '734 patent is asserted: *WiTricity Corp. v. Momentum Dynamics Corp.*, Case No. 1:20-CV-01671-MSG (D. Del.). Pet. 76; Paper 3, 1.

C. The '734 patent

The '734 patent relates to using oscillatory resonant electromagnetic modes for wireless non-radiative energy transfer. Ex. 1001, 1:19–22. A

first resonator structure is provided having a resonant frequency ω_1, and a second resonator structure is provided having a resonant frequency ω_2, separated by a distance D. *Id.* at 2:11–21. The '734 patent contemplates transferring energy non-radiatively between the first and second resonator structures through coupling of the resonant-field evanescent tails of the resonator structures. *Id.* at 2:21–26. "Non-radiative" is defined by the '734 patent as meaning that "D is smaller than each of the resonant wavelengths λ_1 and λ_2, where c is the propagation speed of radiation in the surrounding medium." *Id.* at 2:27–29.

The '734 patent explains that radiative modes of energy transfer do not work well because (1) use of omni-directional antennas leads to wasting a vast majority of the energy into free space, and (2) directed radiation modes using lasers or highly-directional antennas require the existence of an uninterruptible line-of-sight and a complicated tracking system in the case of mobile objects. *Id.* at 1:29–38.

Claims 1 and 6 are each independent and reproduced below, with bracketed headings for claim elements corresponding to those used by Petitioner in its Petition, to facilitate discussion and analysis:

> 1. [Preamble] A method of transferring electromagnetic energy comprising:
>
> [a] providing a first electromagnetic resonator structure
>
> [i] receiving energy from an external power supply,
>
> [ii] said first resonator structure having a first mode with a resonant frequency ω_1,
>
> [iii] an intrinsic loss rate Γ_1,
>
> [iv] and a first Q-factor $Q_1 = \omega_1 / (2\Gamma_1)$,
>
> [b] providing a second electromagnetic resonator structure

[i] being positioned distal from said first resonator structure and not electrically wired to the first resonator structure,

[ii] said second resonator structure having a second mode with a resonant frequency ω_2,

[iii] an intrinsic loss rate Γ_2,

[iv] and a second Q-factor $Q_2 = \omega_2 / (2\Gamma_2)$,

[c] transferring electromagnetic energy from said first resonator structure to said second resonator structure over a distance D that is smaller than each of the resonant wavelengths λ_1 and λ_2 corresponding to the resonant frequencies ω_1 and ω_2, respectively,

[d] wherein the electromagnetic resonator structures are designed to have $Q_1 > 100$ and $Q_2 > 100$.

Ex. 1001, 11:39–58.

6. [Preamble] An electromagnetic energy transfer system comprising:

[a] a first electromagnetic resonator structure

[i] receiving energy from an external power supply,

[ii] said first resonator structure having a first mode with a resonant frequency ω_1,

[iii] an intrinsic loss rate Γ_1,

[iv] and a first Q-factor $Q_1 = \omega_1 / (2\Gamma_1)$, and

[b] a second electromagnetic resonator structure

[i] being positioned distal from said first resonator structure and not electrically wired to the first resonator structure,

[ii] said second resonator structure having a second mode with a resonant frequency ω_2,

[iii] an intrinsic loss rate Γ_2,

[iv] and a second Q-factor $Q_2 = \omega_2 / (2\Gamma_2)$,

[c] wherein said first resonator transfers electromagnetic energy to said second resonator over a distance D that is smaller than each of the resonant wavelengths λ_1 and λ_2 corresponding to the resonant frequencies ω_1 and ω_2, respectively,

[d] wherein the electromagnetic resonator structures are designed to have $Q_1 > 100$ and $Q_2 > 100$.

Id. at 11:64–12:18.

D. Evidence Relied on by Petitioner

Petitioner relies on the following evidence:[1]

References		Date	Exhibit
Stark	Joseph C. Stark, III, *Wireless Power Transmission Utilizing a Phased Array of Tesla Coils* (2004)	Published 2004	Ex. 1006
Mecke	R. Mecke & C. Rathge, *High Frequency Resonant Inverter for Contactless Energy Transmission over Large Air Gap,* 2004 IEEE 35th Annual Power Electronics Specialists Conference (June 20, 2004)	Published June 20, 2004	Ex. 1007

Petitioner also relies on the Declaration of Darrin J. Young, Ph.D. (Ex. 1003).

E. Asserted Grounds of Unpatentability

Petitioner asserts that the challenged claims are unpatentable on the following grounds:

[1] The '734 patent issued from Application 11/481,077, filed July 5, 2006. Ex. 1001 at codes (21), (22). The '734 patent also claims priority to Provisional Application 60/698,442, filed July 12, 2005. *Id.* at code (60).

Claims Challenged	35 U.S.C. §[2]	Basis
1–7, 13, 19–22, 25, 26, 29, 30, 33, 34, 37, 38, 41, 42, 45, 46, 49, 50, 53, 54, 57–61, 64, 67–70	103	Stark
61, 62, 64, 65	103	Stark
61, 62, 64, 65	103	Stark, Mecke

III. ANALYSIS

A. Burden of Proof

To prevail at trial in its challenge to Patent Owner's claims, if review is instituted, Petitioner must demonstrate by a preponderance of the evidence that the claims are unpatentable. 35 U.S.C. § 316(e); 37 C.F.R. § 42.1(d) (2020). That burden never shifts to the patentee. *Dynamic Drinkware, LLC v. Nat'l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015).

B. Level of Ordinary Skill

Petitioner asserts that one of ordinary skill in the art in July 2005 (1) "would have had at least a bachelor's degree in electrical engineering (or equivalent) and at least two to three years of industry or equivalent research experience in the field of wireless power transfer, and (2) "would have been familiar with the use of induction to provide power or data wirelessly." Pet. 4. Patent Owner has not made its own assertion of the level of ordinary

[2] The Leahy-Smith America Invents Act ("AIA"), Pub. L. No. 112–29, 125 Stat. 284, 287–88 (2011), revised 35 U.S.C. §§ 102 and 103 effective March 16, 2013. Because the effective filing date of the '734 patent is prior to March 16, 2013 (Ex. 1001, code (22)), we refer to the pre-AIA versions of §§ 102, 103.

skill. Nor has Patent Owner expressed disagreement with Petitioner's articulation.

Petitioner's use of the qualifier "at least" renders Petitioner's articulation vague and potentially overlapping with the level of skill of an expert. On this record, we adopt Petitioner's articulation of the level of ordinary skill, but delete the qualifier "at least" for the level of education and for the amount of experience, to keep the level from being vague and overbroad and extending into the level of an expert. What remains appears consistent with what is reflected by the content of the applied prior art references. *Cf. Okajima v. Bourdeau*, 261 F.3d 1350, 1354–55 (Fed. Cir. 2001) (the applied prior art may reflect an appropriate level of skill).

In summary, one with ordinary skill in the art at the pertinent time period would have had a bachelor's degree in electrical engineering (or equivalent) and two to three years of industry or equivalent research experience in the field of wireless power transfer, and would have been familiar with the use of induction to provide power or data wirelessly.

C. Claim Construction

We use the same claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. § 282(b), including construing the claim in accordance with the ordinary and customary meaning of such claim as understood by one of ordinary skill in the art and the prosecution history pertaining to the patent. 37 C.F.R. § 42.100(b) (2020). The claim construction standard set forth in *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005) (en banc) is applicable.

Claim terms are generally given their ordinary and customary meaning as would be understood by one with ordinary skill in the art in the context of the specification, the prosecution history, other claims, and even

extrinsic evidence including expert and inventor testimony, dictionaries, and learned treatises, although extrinsic evidence is less significant than the intrinsic record. *Phillips*, 415 F.3d at 1312–17. Usually, the specification is dispositive, and it is the single best guide to the meaning of a disputed term. *Id.* at 1315.

The specification may reveal a special definition given to a claim term by the patentee, or the specification or prosecution history may reveal an intentional disclaimer or disavowal of claim scope by the inventor. *Id.* at 1316. If an inventor acts as his or her own lexicographer, the definition must be set forth in the specification with reasonable clarity, deliberateness, and precision. *Renishaw PLC v. Marposs Societa' per Azioni*, 158 F.3d 1243, 1249 (Fed. Cir. 1998). The disavowal, if any, can be effectuated by language in the specification or the prosecution history. *Poly-America, L.P. v. API Indus., Inc.*, 839 F.3d 1131, 1136 (Fed. Cir. 2016).

Only those claim terms that are in controversy need to be construed, and only to the extent necessary to resolve the controversy. *Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017); *Wellman, Inc. v. Eastman Chem. Co.*, 642 F.3d 1355, 1361 (Fed. Cir. 2011); *Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999).

Petitioner has not proposed a construction for any claim term, and states that "no claim terms require a specific construction." Pet. 6. Patent Owner also has not proposed a construction for any claim term. Prelim. Resp. 8.

For this decision, no claim term requires an express construction.[3]

D. Alleged Obviousness of Claims 1–7, 13, 19–22, 25, 26, 29, 30, 33, 34, 37, 38, 41, 42, 45, 46, 49, 50, 53, 54, 57–61, 64, and 67–70 over Stark

1. Law on Obviousness

A claim is unpatentable under 35 U.S.C. § 103 if the differences between the claimed subject matter and the prior art are such that the subject matter, as a whole, would have been obvious to a person having ordinary skill in the art to which said subject matter pertains. *See KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations, including (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of skill in the art; and (4) where in evidence, so-called secondary considerations, including commercial success, long-felt but unsolved needs, failure of others, and unexpected results ("the *Graham* factors"). *Graham v. John Deere Co. of Kansas City*, 383 U.S. 1, 17–18 (1966).

2. Overview of Stark

Stark is a Master's Degree thesis discussing the theory and design of coupled resonant systems and how they can be linked in a phased array for the wireless transmission of electrical power. Ex. 1006, 3. Specifically, Stark makes use of multiple Tesla coils, arranged in an array and synchronized in frequency, to generate high voltage, high frequency electrical power, to be radiated to a receiver through an antenna array. *Id.* at

[3] We need not determine whether the preambles of claims 1 and 6 are limiting because, as discussed below, even if they are limiting, Petitioner has adequately accounted for them.

11. Stark states: "this project considers a new topology of multiple, separate Tesla coils operated in synchronization so as to create an array with directional attributes." *Id.* at 12. Stark further states:

> For some applications, a focused radiation pattern would be optimal, while for others, such as nanosensors spaced about a wide area, an omnidirectional radiation pattern would be appropriate. The receiver is itself a resonant system tuned to the high frequency of the radiated power for maximum power transfer, much as a radio receiver must be tuned to a given frequency for higher reception gain.

Id. at 11–12.

In Chapter 3, Stark explains the basic component of its method and system, the Tesla coil. *Id.* at 12. Stark states:

> The second [subsequent] chapter [Chapter 3] discusses how two second order systems can be coupled to yield a single fourth order circuit with a mutual inductance coupling [of] the inductors of the two circuits. These two second order circuits are known as the primary and secondary of the Tesla Coil. As the traditional Tesla coil is comprised of two coupled second order systems sharing a resonant frequency, the Tesla coil is also referred to as a coupled resonant system throughout this thesis. The issues of matched resonant frequencies and the interaction of quality factors are presented.

Id.

In Chapter 3, Stark states: "The 'magic' behind Tesla coil operation is the use of resonant circuits coupled in such a way as to take energy stored in the primary side of the circuit and transfer it into the secondary coil in a modified state." *Id.* at 41. Figure 3-1 is an illustration of the basic topology of a fourth order Tesla coil circuit and is reproduced below:

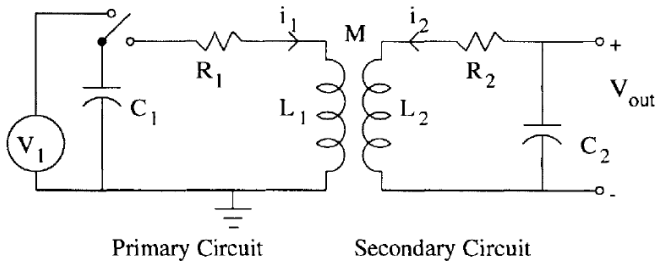


Figure 3-1: Two second order circuits with inductive coupling.

Figure 3-1 shows two second order circuits with inductive coupling, in a basic fourth order topology. *Id.* at 42.

Stark describes:

> When combining two second order circuits, each with its own resonant frequency and Q factor, *the behavior of the total, fourth order system is not simply a sum, difference, or average of the two constituent circuits' parameters*. Instead, different parts of the circuit resonate at different frequencies related to the original independent fundamental frequencies. As the system is driven by an external source, the energy it transfers to the circuit is moved between the energy storage elements of the circuit according to each devices' constitutive relations. The result is that *the circuits will load one another and affect their natural resonance frequencies and individual Q factors*.

Id. at 42 (emphasis added). Stark further describes:

> *The individual values of the quality factors are unimportant here so long as their product is constrained to* $Q_1Q_2 = 1 / k^2_{crit} = 400$ and they are within the same order of magnitude. This is reasonable considering the large resistance of the secondary coil due to the high frequency of operation. The resistance for the 18 gauge wire selected for the secondary is: $R_{DC} = 1.75 \cdot 10^{-4}\ \Omega$ while $\Phi_{AC} = 379$ and $\Phi_M = 1.93$ giving a net secondary coil effective resistance at 1MHz of $R_2 \approx 0.13\ \Omega$. *This yields* $Q_2 \approx 87$. *This is most likely an upper bound to the secondary coil performance.*
>
> The use of smaller gauge wire (larger diameter), such as 10 or 12 gauge, would allow for higher quality factors at 1 MHz or higher resonant frequencies. However, coils using such large

> wire are typically large themselves, usually much longer than the secondary coil length $b_2 = 0.325$ meters seen in this example.

Id. at 129 (emphasis added).

Stark still further describes that "*[t]he coupling coefficient, k, is the single most important factor in determining the operation of the Tesla coil.*" *Id.* at 93. In that connection, Stark explains that when the quality factors are roughly equal, $k = k_{crit}$ "is the coupling that yields a maximum gain when the system is driven at the frequency w_n." *Id.* at 80. Stark describes that when $k = k_{crit}$, the two circuits are impedance matched and a maximum amount of power can be transferred from source to load. *Id.* at 80–81. Additionally, Stark describes that k is bounded to between 0 and 1, that "[t]he greater the k the more flux transferred between the two coupled inductors," and that "as k approaches unity, the system approaches that of an ideal transformer with complete energy transfer." *Id.* at 55, 99, 228. Stark gives the following formula for k_{crit}:

$$k_{crit} = \frac{1}{\sqrt{Q_1 Q_2}}$$

Id. at 47.

3. Independent Claim 1

Petitioner accounts for elements 1 [Preamble], 1[a], 1[a][i], 1[a][ii], 1[a][iii], 1[a][iv], 1[b], 1[b][i], 1[b][ii], 1[b][iii], and 1[b][iv] on pages 11–33 of the Petition, where Petitioner asserts that Stark discloses each and every one of these elements. Pet. 11–33. Petitioner's assertions and arguments are supported by the cited portions of Stark and the cited testimony of Dr. Young. *Id.* Patent Owner does not present contrary arguments for these

elements. We are sufficiently persuaded that Stark discloses elements 1 [Preamble], 1[a], 1[a][i], 1[a][ii], 1[a][iii], 1[a][iv], 1[b], 1[b][i], 1[b][ii], 1[b][iii], and 1[b][iv].

On pages 33–36 of the Petition, Petitioner accounts for how Stark discloses claim element 1[c]. Pet. 33–36. Claim element 1[c] reads as follows:

> transferring electromagnetic energy from said first resonator structure to said second resonator structure over a distance D that is smaller than each of the resonant wavelengths λ_1 and λ_2 corresponding to the resonant frequencies ω_1 and ω_2, respectively,

Ex. 1001, 11:52–56. We have reviewed Petitioner's accounting for this limitation on pages 33–36 and are satisfied that the limitation is met by Stark. Patent Owner asserts that the limitation is not met by Stark but does not point out how Petitioner's accounting is deficient with respect to the distance D requirement between the first resonator structure and the second resonator structure. Prelim. Resp. 19–22. Patent Owner also does not deny that electromagnetic energy is transferred from the first resonator structure to the second resonator structure. *Id.*

Instead, Patent Owner argues, on a very general level, that "Stark makes clear that its system involves radiative energy transfer," and "Stark goes so far as to distinguish its system from non-radiative approaches, such as those using 'magnetic induction' (like the '734 patent, 7:49–52)." Prelim. Resp. 19. Patent Owner notes that the '734 patent, "conversely, describes a system for 'wireless **non-radiative** energy transfer'" and that "[t]he non-radiative character of the '734 patent's techniques is also present in the claims." *Id.* at 19–20. Patent Owner asserts:

> For example, independent claim 1 recites "transferring magnetic energy from said first resonator structure to said second resonator structure **over a distance D that is smaller than each of the resonant wavelengths λ_1 and λ_2** corresponding to the resonant frequencies ω_1 and ω_2, respectively." *Id.*, claim 1. The specification repeatedly makes clear that the claim language emphasized above is the definition of "non-radiative."

The assertion is misplaced. The fact that Stark involves radiative transfer of energy does not mean it does not also disclose non-radiative transfer of energy. As discussed above in Section II.D.2, Stark contemplates linking multiple Tesla coils to form a phased array and to radiate the energy generated from the phased array to remote places through an antenna. Ex. 1006, 11. Petitioner, however, is relying on the internal configuration of a single Tesla coil, where energy is transferred from the primary coil to the secondary coil in a Tesla coil, by magnetic induction, also as discussed above in Section II.D.2, to meet limitation 1[c] which includes the referenced definition for "non-radiative." Pet. 33–36. Further, Patent Owner nowhere explains how Petitioner erred in accounting for the distance D requirement in limitation 1[c].

Accordingly, we are sufficiently persuaded that Stark discloses limitation 1[c].

What remains is limitation 1[d]: "wherein the electromagnetic resonator structures are designed to have $Q_1 > 100$ and $Q_2 > 100$." Ex. 1001, 11:57–58. Petitioner attempts to account for this limitation on pages 37–49 of the Petition. Pet. 37–49.

Petitioner asserts "Stark discloses using its formulas to design its system with 'intended operational specifications' such that the Q of the primary circuit and of the secondary circuit are each 1,000." Pet. 39 (citing Ex. 1006, 52–53 (Fig. 3–9)). Patent Owner points out, however, that Q_1 =

$Q_2 = 1000$ is part of an example of a "mistuned" circuit in Stark. Prelim. Resp. 13. Patent Owner is correct. Immediately prior to Figure 3–9, Stark states: "When the primary and secondary circuits are not tuned to the same frequency, ω_n, the mathematics describing the situation becomes complicated. To better understand the dynamics, a physical intuition of what happens must be developed." Ex. 1006, 52. That is the beginning of a Subsection 3.1.3 titled "Physical interpretation $\omega_1 \neq \omega_2$" following Subsection 3.1.2 titled "Solution with primary and secondary tuned together." *Id.* at 46, 52.

However, Patent Owner does not identify any disclosure in Stark to the effect that a circumstance where the resonant frequency ω_1 of the first resonator structure or primary coil does not equal the resonant frequency ω_2 of the second resonator structure or secondary coil is unworkable or is inoperative. Stark states that where $\omega_1 \neq \omega_2$, the mathematics "becomes more complicated" and "a physical intuition of what happens must be developed." *Id.* at 52. Stark also states: "If the coils are mistuned, there is no simple procedure for determining k or when $k = k_{crit}$ save through measuring flux and watching for peaks in the output voltage waveform, although they may be misshaped beats." *Id.* at 127. Further, claim 1 has no requirement that ω_1 must equal ω_2. Therefore, this argument by Patent Owner does not undermine Petitioner's showing that Stark does disclose one circumstance where $Q_1 = Q_2 = 1000$.

But limitations 1[c] and 1[d] have to be met together, not separately in disparate disclosures of Stark. To meet limitation 1[c], Petitioner relies on the parameters of the working prototype that was constructed by the author of Stark and described in Chapter 7 of Stark. Pet. 33–37. The $Q_1 = Q_2 = 1000$ notion is in a separate section for developing an intuition where $\omega_1 \neq$

ω_2. *Id.* at 52. Notably, Stark indicates that its prototype is constructed with a common resonant frequency among all coils. *Id.* at 174. Regarding its constructed prototype, Stark specifically states: "At this point, it remains to tune the four coils such that they are all resonating at the same frequency."[4] *Id.* at 190. Further, in Chapter 8, where Stark specifically discusses measurements from the prototype, Stark reveals that the Qs designed into the prototype are: $Q_1 = 32$, $Q_2 = 34$; $Q_1 = 23$, $Q_2 = 22$; $Q_1 = 29$, $Q_2 = 26$. *Id.* at 206, 212, 215. The prototype was not designed or implemented with $Q_1 = Q_2 = 1000$. Thus, Petitioner has not shown satisfaction of limitations 1[c] *and* 1[d], by relying on the disclosure of $Q_1 = Q_2 = 1000$.

Petitioner further notes that Stark in Figure 3-3 and Figure 3-9 make $Q_1 = Q_2 = 100$. Pet. 40–41. Patent Owner asserts that, like the case of $Q_1 = Q_2 = 1000$, the case of $Q_1 = Q_2 = 100$ reflects a situation where the resonant circuits are "mistuned." Prelim. Resp. 13. Regardless of whether $Q_1 = Q_2 = 100$ reflects the values of Q for a "mistuned" circuit, the case of $Q_1 = Q_2 = 100$ has the same above-discussed problem as the case of $Q_1 = Q_2 = 1000$ in that the prototype on which Petitioner relies to meet limitation 1[c] was not designed or implemented with $Q_1 = Q_2 = 100$.[5]

[4] There are four coils instead of two because Stark is building a phased array of two Tesla coils each of which has a primary coil and a secondary coil. *Id.* at 145, 179, 187–188.

[5] Petitioner argues that disclosure of $Q_1 = Q_2 = 100$ would have rendered obvious $Q_1 > 100$ and $Q_2 > 100$, because the two are so close, and Petitioner argues that disclosure of $Q_1 = Q_2 = 100$ is disclosure of $Q_1 > 100$ and $Q_2 > 100$ because in practice Q would fluctuate slightly and unavoidably sometimes exceed 100. Pet. 41–43. We need not reach either of these arguments because, as discussed above, Stark does not disclose limitation 1[c] together with $Q_1 = Q_2 = 100$.

Nonetheless, Petitioner asserts that it would have been obvious to one with ordinary skill in the art to set a high value for all Qs in the system. Specifically, Petitioner asserts:

> A POSA would have understood that such high Q values were beneficial because they increase the power and efficiency of the system. As Stark explains, maximizing Q leads to higher voltage transfer: "Holding other network parameters constant, if the quality factors are increased, the initial peak output voltage will increase." Stark 79; Young Decl. ¶¶ 207–09. Stark also explains that maximizing Q leads to increased transfer efficiency, as "[t]here is no fundamental limit to the unloaded energy transfer efficiency save for constraints on the quality factors and the coupling coefficient." Stark 101; Young Decl. ¶¶ 207–09. Because the coupling coefficient, k, is bounded by $0 \leq k \leq 1$ and therefore relatively constraining, a POSA would have been motivated to use high Q values instead to maximize the "energy transfer efficiency" of Stark's system. Young Decl. ¶¶ 207–09. A POSA would have desired to transfer large amounts of power, and to transfer power more efficiently to improve Stark's system.

Pet. 44.

On this record, and for reasons discussed below, the disclosures cited by Petitioner are not consistent with numerous other express disclosures of Stark. Petitioner has over-simplified Stark's disclosure as well as engaged in selective picking and choosing of Stark's teachings. "It is impermissible within the framework of section 103 to pick and choose from any one reference only so much of it as will support a given position to the exclusion of other parts necessary to the full appreciation of what such reference fairly suggests to one skilled in the art." *Bausch & Lomb, Inc. v. Barnes-Hind/Hydrocurve, Inc.*, 796 F.2d 443, 448 (Fed. Cir. 1986) (quoting *In re Wesslau*, 353 F.2d 238, 241 (CCPA 1965)). "The relevant portions of a reference include not only those teachings which would suggest particular

aspects of an invention to one having ordinary skill in the art, but also those teachings which would lead such a person away from the claimed invention." *In re Mercer*, 515 F.2d 1161, 1166 (CCPA 1975). Petitioner's selectively picking and choosing without an adequate explanation amounts to a critical deficiency of the Petition. Petitioner does not identify testimony of Dr. Young which would explain the various contrary disclosures of Stark.

Petitioner does not explain Stark's Figure 3–31, reproduced below:

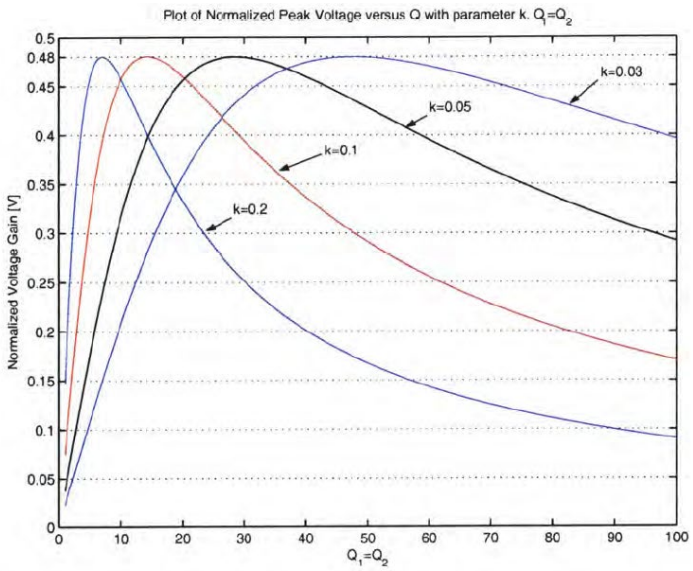


Figure 3-31: Plot of the normalized peak voltage versus Q with parameter k. Note that $\omega_n = 1$, $Q_1 = Q_2$, and $R_1 = R_2 = 1$.

Figure 3-31 illustrates normalized voltage gain based on variations in Q. Ex. 1006, 84. It shows that except for small values of Q, the voltage gain gets smaller as Q gets higher, the opposite of what Petitioner contends. *See* Pet. 44.

Petitioner also does not explain the following formula in Stark for determining k_{crit}, "the coupling coefficient that yields a maximum gain when the system is driven at the frequency w_n" (Ex. 1006, 80):

$$k_{crit} = \frac{1}{\sqrt{Q_1 Q_2}}$$

Ex. 1006, 47. According to this formula, higher Qs would lead to a lower coupling coefficient,[6] meaning less efficiency in energy transfer.

Petitioner's assertion also does not address the interplay of limitation 1[c] with limitation 1[d]. Petitioner places its focus on limitation 1[d] without regard to limitation 1[c] which, according to Stark, is related to limitation 1[d]. Stark describes the following relationship between Quality factor Q and resonant frequency ω_n:

Parameter Estimation	$Q =$	$\omega_n =$
Series	$Q = \frac{\omega_n L}{R}$	$\omega_n = \frac{1}{\sqrt{LC}}$
Parallel	$Q = \omega_n RC$	$\omega_n = \frac{1}{\sqrt{LC}}$

Ex. 1006, 39. As the formulas indicate, Quality factor Q is related to resonant frequency ω_n. According to limitation 1[c], resonant wavelength is related to resonant frequency. Petitioner's reasoning does not explain the effect of the condition imposed by limitation 1[c]. For example, if either Q_1 or Q_2 in limitation 1[d] were to increase, then ω_1 and ω_2 in limitation 1[c] would correspondingly increase, per these formulas. Petitioner does not account for how an increase of Q_1 or Q_2 in limitation 1[d] would affect the relationship between ω_1 and ω_2 and the distance D in limitation 1[c].

[6] For $Q_1 > 1$ and $Q_2 > 1$, as Stark uses in the prototype. Ex. 1006, 206, 212, 215 ($Q_1 = 32$, $Q_2 = 34$; $Q_1 = 23$, $Q_2 = 22$; $Q_1 = 29$, $Q_2 = 26$).

Further, Petitioner's above-quoted suggestion to alter Q rather than coupling coefficient *k* assumes that Q is entirely independent from coupling coefficient *k*. That does not appear to be the case based on the formula reproduced above for determining k_{crit}. *See* Ex. 1006, 47.

Stark also describes that "*[t]he coupling coefficient, k, is the single most important factor in determining the operation of the Tesla coil.*" *Id.* at 93. Stark explains that when the quality factors are roughly equal, $k = k_{crit}$ "is the coupling that yields a maximum gain when the system is driven at the frequency w_n." *Id.* at 80. Stark describes that *k* is bounded to between 0 and 1, that "[t]he greater the *k* the more flux transferred between the two coupled inductors," and that "as *k* approaches unity [1], the system approaches that of an ideal transformer with complete energy transfer." *Id.* at 55, 99, 228. According to Stark's formula reproduced above, increasing Q_1 and Q_2 will decrease k_{crit}, leading to a smaller coupling coefficient which reflects a lower amount of energy transfer. An exclusive focus on increasing all Qs in subsystems that interact with each other is contrary to Stark's disclosure.

There are numerous other express disclosures in Stark that are contrary to Petitioner's assertions. For example, Stark describes: "*The individual values of the quality factors are unimportant here so long as their product is constrained to* $Q_1Q_2 = 1 / k^2_{crit} = 400$ *and they are within the same order of magnitude.*" *Id.* at 129. But if both Q_1 and Q_2 were greater than 100 as claimed, Q_1Q_2 would be greater than 400. Thus, an exclusive focus on increasing all Qs in the system is contrary to Stark's disclosure.

As another example of contrary disclosure, Stark describes:

> When combining two second order circuits, each with its own resonant frequency and Q factor, *the behavior of the total, fourth order system is not simply a sum, difference, or average of the two constituent circuits' parameters*. Instead, different

> parts of the circuit resonate at different frequencies related to the original independent fundamental frequencies. As the system is driven by an external source, the energy it transfers to the circuit is moved between the energy storage elements of the circuit according to each devices' constitutive relations. The result is that *the circuits will load one another and affect their natural resonance frequencies and individual Q factors*.

Id. at 42. Thus, according to Stark, when a system includes two multiple resonant circuits, as Stark's Tesla coil does, maximizing individual Quality factors may not be good for the overall system. An exclusive focus on increasing all Qs in subsystems that interact with each other is contrary to Stark's disclosure.

Further, Stark also states that Q ≈ 87 is most likely the upper bound for the secondary coil. *Id.* at 129. Although, as noted by Petitioner (Pet. 40), Stark also states that use of smaller gauge (larger diameter) wires could allow for a higher Quality factor (*id.*), Petitioner does not explain to what extent Q can be effectively increased simply by using larger diameter wires, without changing other characteristics of the resonant circuit. Further, that Q could be made larger does not mean one with ordinary skill in the art would have wanted to make Q larger. *See Belden Inc. v. Berk-Tek LLC*, 805 F.3d 1064, 1073 (Fed. Cir. 2015) ("obviousness concerns whether a skilled artisan not only could have made but would have been motivated to make the combinations or modifications of prior art to arrive at the claimed invention").

Petitioner asserts: "A POSA would not be motivated to use small Q, for example, based on Stark's disclosure that small Q values result in weaker energy transfer: 'for very small Q . . . the system response decays before any oscillations occur.' Stark 56; Young Decl. ¶ 210." Pet. 49. Petitioner also asserts "Stark teaches that Q values must be 'large enough' to not damp

out the waveform before [] the desired dynamics have occurred.' Stark 82; Young Decl. ¶¶ 209–10." *Id.* These arguments are overly general and thus unpersuasive, because Stark's prototype, discussed above, conveys that the following Q values are sufficiently big and not too small: $Q_1 = 32$, $Q_2 = 34$; $Q_1 = 23$, $Q_2 = 22$; $Q_1 = 29$, $Q_2 = 26$. Ex. 1006, 206, 212, 215. Stark does not disclose or suggest that Q values must be over 100.

Petitioner refers to the Q values implemented in Stark's prototype as "un-optimized." *Id.* However, Petitioner cites to no evidentiary support for that assertion and makes no showing that corresponding "optimized" Q_1 and Q_2 for Stark's disclosed prototype would be > 100. The Q values in Stark's prototype are selected by design. In that regard, Stark describes: "There is a straightforward procedure for finding the parameters Q_1, Q_2, and k that best fit the system." Ex. 1006, 207. Stark uses that procedure to arrive at $Q_1 = 32$ and $Q_2 = 34$, the highest Q values implemented in its prototype. *Id.* at 207–209.

Petitioner has not adequately addressed the above-noted disclosures in Stark that are contrary to its exclusive focus on a desire to increase Q. Although on pages 45–48 of the Petition, Petitioner cites to numerous additional material outside of Stark, which Petitioner asserts (Pet. 45) are consistent with its reading of Stark, all such materials appear to have a single focus on increasing Q to the exclusion of everything else. The Petition does not address how such materials elucidate or otherwise explain the numerous specific contrary disclosures from within Stark itself as discussed above. Thus, these additional materials do not strengthen, meaningfully, Petitioner's assertions based on Stark.

Petitioner has not meaningfully or adequately explained numerous specific contrary disclosures of Stark. Neither has Dr. Young. Petitioner's

exclusive focus on increasing the value of Q reflects selectively picking and choosing of only so much of Stark's disclosure that supports Petitioner's contention to the exclusion of other disclosures which are necessary for a full appreciation of what Stark reasonably would have conveyed or suggested to one with ordinary skill in the art.

Finally, Petitioner relies on the prosecution history of related European Application and asserts:

> Further, while not considered during U.S. prosecution, [Stark] was used to reject substantially similar claims during prosecution of a European equivalent. EP 2306615 FH 73–77 (Ex. 1011); *see also* id. at 49 (listing of rejected claims). The Examiner concluded that the independent claims of that application — which included substantially the same limitations as independent claims 1 and 6 of the '734 patent, plus additional narrower limitations — were not patentable over Stark. *Id.* 74–77. Patent Owner overcame Stark only by adding numerous additional limitations, including a limitation that is not present in any claim of the '734 patent: "wherein the second resonator structure . . . is part of a mobile wireless receiver, and wherein the mobile wireless receiver is any of a robot, a vehicle, or a computer." *Id.* 151. Stark is the primary reference herein.

Pet. 5. The argument is unpersuasive, because the European prosecution history shows that substantive arguments also were made in response to the rejection of what Petitioner regards as "substantially similar claims" based on features in the rejected claims rather than the newly added limitation. For instance, there the patent applicant argued: "[Stark] does not teach or suggest that Q_1 and Q_2 should be designed to be as large as possible to maximize efficiency," and "[t]o the contrary, [Stark] is clearly focused on teaching how to optimize the coupling coefficient k given *fixed* values for Q_1 and Q_2, i.e., to set the value of k in terms of k_{crit} = 1 /sqrt(Q1*Q2), instead of the opposite." Ex. 1011, 139. The patent applicant further asserts: "*The*

coupling coefficient, k, is the single most important factor on determining the operation of the Tesla coil." *Id.* The patent applicant also argued: "On p. 84, Fig. 3-31 (reproduced below) Stark focuses on maximizing the pulsed voltage gain with respect to Q and shows that the pulsed voltage gain in fact *decreases* as Q increases beyond a certain value, thereby expressly teaching away from high Q." *Id.* at 140. The patent applicant summarizes as follows: "In short, the Examining Division's interpretation of [Stark] as teaching or suggesting $Q_1 > 100$ and $Q_2 > 100$, and especially $Q_1 > 200$ and $Q_2 > 200$ as in claim 1, is contrary to the express practical teachings in [Stark] and certainly contrary to the general understanding in the art as evidenced by the subsequent acclaim received by the inventors." *Id.* at 143. These arguments also had a role in obtaining allowance of the related European Application.

For the foregoing reasons, Petitioner has not shown a reasonable likelihood that it would prevail in establishing obviousness of claim 1 over Stark.

4. Independent Claim 6

Claim 6 is an apparatus claim substantively essentially corresponding to the method claim of claim 1. Step limitation 1[c] of claim 1 appears as a function limitation 6[c] in claim 6. Limitation 1[d] of claim 1 appears exactly the same as limitation 6[d] in claim 6. Both Petitioner and Patent Owner commonly address claims 1 and 6, with no separate arguments directed to one but not the other. The deficiency of Petitioner's accounting for claim 1, as discussed above, equally applies to claim 6.

Accordingly, Petitioner has not shown a reasonable likelihood that it would prevail in establishing obviousness of claim 6 over Stark.

5. Dependent Claims 2–5, 7, 13, 19–22, 25, 26, 29, 30, 33, 34, 37, 38, 41, 42, 45, 46, 49, 50, 53, 54, 57–61, 64, 67–70

Claims 2–5, 7, 13, 19–22, 25, 26, 29, 30, 33, 34, 37, 38, 41, 42, 45, 46, 49, 50, 53, 54, 57–61, 64, and 67–70 each depend, directly or indirectly, from claim 1 or claim 6, and incorporate all the limitations of the independent claim from which it depends. The deficiency of Petitioner's accounting for claims 1 and 6 equally applies to these dependent claims.

Accordingly, Petitioner has not shown a reasonable likelihood that it would prevail in establishing obviousness of claims 2–5, 7, 13, 19–22, 25, 26, 29, 30, 33, 34, 37, 38, 41, 42, 45, 46, 49, 50, 53, 54, 57–61, 64, and 67–70 over Stark.

E. Alleged Obviousness of Claims 61, 62, 64, and 65 over Stark

Claims 61 and 62 each depend from claim 1, and claims 64 and 65 each depend from claim 6. Ex. 1001, 11:32–36. The Petition's deficiency with respect to claim 1, as discussed above, equally applies to claims 61 and 62. The Petition's deficiency with respect to claims 6, as discussed above, equally applies to claims 64 and 65.

Accordingly, Petitioner has not shown a reasonable likelihood that it would prevail in establishing obviousness of claims 61, 62, 64, and 65 over Stark.

F. Alleged Obviousness of Claims 61, 62, 64, and 65 over Stark and Mecke

Claims 61 and 62 each depend from claim 1, and claims 64 and 65 each depend from claim 6. Ex. 1001, 11:32–36. The Petition's deficiency with respect to claim 1, as discussed above, equally applies to claims 61 and 62. The Petition's deficiency with respect to claims 6, as discussed above,

equally applies to claims 64 and 65. Mecke, as applied by Petitioner, does not cure that deficiency.

Accordingly, Petitioner has not shown a reasonable likelihood that it would prevail in establishing obviousness of claims 61, 62, 64, and 65 over Stark and Mecke.

IV. CONCLUSION

Petitioner has not shown a reasonable likelihood that it would prevail in establishing unpatentability of any of claims 1–7, 13, 19–22, 25, 26, 29, 30, 33, 34, 37, 38, 41, 42, 45, 46, 49, 50, 53, 54, 57–62, 64, 65, and 67–70 of the '734 patent.

V. ORDER

It is

ORDERED that the Petition is *denied*, and no *inter partes* review is instituted on any claim over any alleged ground of unpatentability.

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